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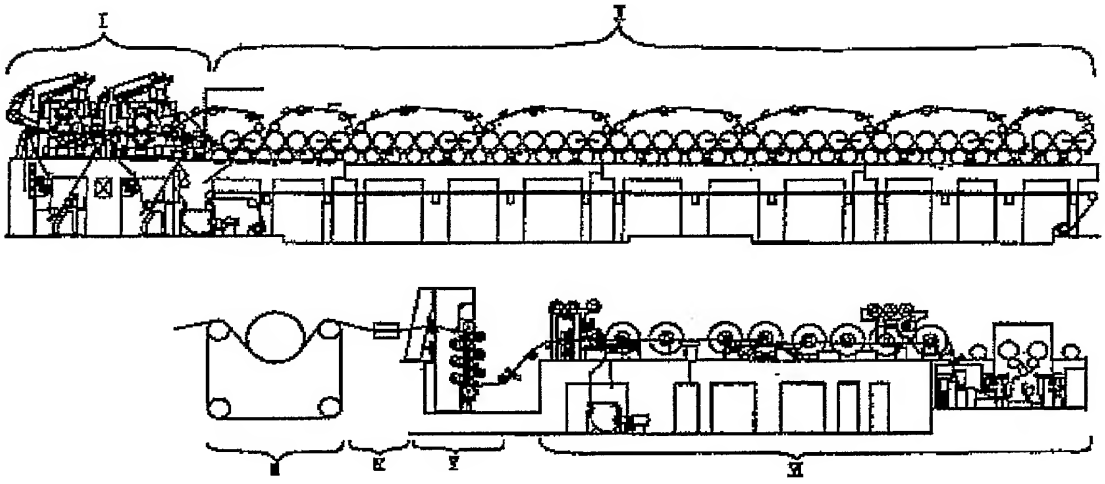
(54) Title: APPARATUS AND METHOD FOR MANUFACTURING PAPER OR BOARD AND THUS MANUFACTURED PAPER OR BOARD




(57) Abstract: The invention relates to a paper/board manufacturing method, in which a paper/board web is re-moistened at some point between wet pressing (I) and rewinding (VI), and to an apparatus for implementing the method. In the method, prior to re-moistening, a paper/board web is calendered and/or dried in at least one operation (III) with a metal-belt calender type processing assembly (1), comprising a metal belt (2) adapted to travel around at least one guide element (3), outside said belt being provided at least one counter-element (5) creating a contact surface with the belt, such that between the belt and the counter-element is established a web processing zone (N), the web to be processed being passed therethrough. In the processing assembly, the processing zone length is adjustable by way of arranging the belt guide element and/or shaping the counter-element. Downstream of re-moistening (IV), the paper/board web is subjected to final calendering (V) with a desired calendering technique.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# Apparatus and method for manufacturing paper or board and thus manufactured paper or board

Some grades of printing paper, such as for example SC-paper (supercalendered paper) and grades of board are necessarily manufactured in such a way that a paper/board web is first dried to a condition dryer than the final moisture, followed by re-moistening prior to final calendering. This is the procedure to obtain a sufficiently good moisture profile and to control moisture distribution in the direction of thickness of paper.

It is an object of the present invention to provide an improved method for manufacturing paper or board, in which method a web to be processed is re-moistened prior to final calendering. Another object of the invention is an apparatus for implementing the method, and paper or board manufactured by the method.

As an example, the following description deals with SC-paper (supercalendered paper), in general reference to what is described in the source publication Papermaking Science and Technology, section Papermaking Part 3, Finishing, edited by Jokio M., published by Fapet Oy, Jyväskylä 1999, 361, pp. 53-68. Such SC-paper is but one example of a paper grade that can be manufactured by a method and apparatus of the invention.

SC-papers make up a product line included in magazine papers, in which mechanical pulp constitutes a dominating component and which has no coating. They include usually 50-75% of mechanical pulp, 5-25% of chemical pulp, and 10-35% of a filler. Such paper may also contain deinked pulp (DIP). Typical basis weights are 40-60 g/m$^2$.

Traditionally, SC-paper is calendered with supercalenders comprising 10-12 rolls. Typically, the production of a single paper machine can be handled by 2 or 3 off-line calenders. Calendering speeds vary within the range of 500-700 m/min. Linear loads are typically 300-400 kN/m and water temperature in thermo roll within the range of 80-120°C. The two-sidedness of paper can be controlled by reversed positioning for the top and bottom nips of a calender, by various temperatures or

steaming rates. The steaming of SC-paper in a calender by means of steam showers is an essential part of SC-calendering. Typically, a set of calendering rolls is fitted with 3 or 4 steam boxes for improving the quality of paper. Steam boxes installed at recent times are zone-controlled and closed loop gloss control enables good gloss profiles in a CD-direction. Paper caliper is controlled by means of deflection-compensated top and bottom rolls. SC-C and SC-B grades, which are intermediates between newsprint and smooth SC-papers, can be produced also with two-nip soft calenders. Surface temperature at run is 160-200°C and line loads up to 350 kN/m. Steaming is also an essential part of calendering these grades.

Polymer coatings and high temperatures have been gradually introduced in SC-paper calendering. At present, the trend is towards multi-roll calendering. New paper machines, which run at a speed of 1800-2000 m/min, require as many as 4 supercalenders per paper machine. New calendering concepts permit higher calendering speeds, temperatures and line loads by virtue of polymer coatings. The number of rolls for the most demanding grades is 10 or 12.

A method of the invention for manufacturing paper or board requiring re-moistening at a point between wet pressing and rewinding is characterized in that, prior to re-moistening, a paper/board web is calendered and/or dried in at least one operation with a metal-belt calender type processing assembly, comprising a metal belt adapted to travel around at least one guide element, outside said belt being provided at least one counter-element creating a contact surface with the belt, such that between the belt and the counter-element is established a web processing zone, the web to be processed being passed therethrough, and in which processing assembly the processing zone length is adjustable by way of arranging the belt guide element and/or shaping the counter-element, and in that, downstream of re-moistening, the paper/board web is subjected to final calendering with a desired calendering technique.

An apparatus of the invention is in turn characterized by what is set forth in the characterizing part of claim 3.

In a manufacturing method of the invention, the contact time of a web with a metal belt is adjusted conveniently to the range of about 5-200 ms, preferably to the range of about 20-80 ms, and the temperature of a metal belt is adjusted most conveniently to the range of about 20-400°C, preferably to the range of about 150-200°C. The moisture of a web arriving at the calender is adjustable within the range of about 1-65%, preferably within the range of about 8-15%, depending on contact time with a metal belt and temperatures applied in calendering. The moistening can be effected by means of an on-line moistener upstream of the metal-belt calender.

The counter-element for a metal belt comprises preferably a flexible surface roll, such as a polymer-coated roll, a rubber-coated roll, or an elastomer-surface roll. Another conceivable solution is such that SC-paper is calendered between a thermo roll and a coated metal belt. When using a thermo roll, its temperature is adjusted conveniently to the range of about 20-400°C, preferably to the range of about 150-200°C. The counter-element can also be something other than a roll, for example a shoe or bar assembly.

In a metal-belt calender used in a paper or board manufacturing method of the invention, it is possible to employ at least one press element provided inside the belt for pressing the belt against the counter-element for enhancing a pressure pulse applied to a web passing through the calendering zone. The press element comprises preferably a roll adapted to subject the metal belt to a load stress of about 0-400 kN/m, preferably about 30-100 kN/m. The counter-element for a metal belt comprises preferably a flexible surface roll, such as a polymer-coated roll, a rubber-coated roll, or an elastomer-surface roll. Another conceivable solution is such that e.g. SC-paper is calendered between a thermo roll and a coated metal belt. When using a thermo roll, its temperature is adjusted conveniently to the range of about 20-400°C, preferably to the range of about 150-200°C. The press element can also be something other than a roll, for example a shoe or bar assembly.

Fig. 1 shows one processing apparatus suitable for use in a method of the invention and designed as a belt calender 1, comprising a calendering belt 2 which travels around guide rolls 3, at least some of said guide rolls being displaceable for adjusting the belt's 2 tightness and/or the processing zone length as desired. The

calendering belt 2 travels around a roll 5 disposed on its outside, establishing a calendering zone N between the belt 2 and the roll 5. A material web W to be calendered passes through the calendering zone, being thus exposed to a desired pressure impulse and heat effect as a function of time. Depicted with a dash-and-dot line 9 in fig. 1 is the shape of a pressure effect, when inside the calendering belt 2 is provided a nip roll 4 which functions as a press element and presses the belt against the roll 5 to establish a higher-pressure nip zone within the calendering zone. On the other hand, a dash line 8 depicts the shape of a pressure effect whenever the contact pressure existing in the calendering zone is established solely by means of the belt's 2 tightness as the nip roll 4 is out of contact with the belt 2 (or when there is no nip roll 4 installed inside the belt 2). The roll 5, and likewise the nip roll 4, may or may not be a deflection-compensated roll and can be selected from a group consisting of: a flexible surface roll, such as a polymer-coated roll, a rubber-coated roll or an elastomer-surface roll, a shoe roll, a thermo roll, a metal roll, a fiber roll, and a composite roll. Instead of the roll 4, the press element may comprise some other profilable or fixed-profile press element, which may further consist of several elements successive in a cross-machine direction. The roll-shaped press element 4 may also consist of several elements successive in a cross-machine direction. The press element 4 may have a surface which is designed to be continuous or discontinuous. The press element 4 can also be adapted to be displaceable for varying the processing zone length and/or the belt's tightness.

In the processing apparatus of fig. 1, the nip roll 4 comprises a shoe roll. Reference numeral 6 represents heating elements, such as for example an induction heater, an infrared radiator, a gas burner or a capacitive heater. The processing apparatus can be provided with elevated temperatures, for example from higher than about 100°C to higher than about 200°C and even to as high as 400°C, depending on a particular application.

Fig. 2 shows schematically one embodiment for a production line applying the inventive method, depicting the line segments from a press section I onwards. The press section I is followed by a drying section II. The drying section is followed by a treatment with a metal-belt calender assembly III and then by a re-moistening operation IV, downstream of which is a final calendering operation V, and ultimately

finishing operations VI which include e.g. winding operations and slitting. In this example, the final calendering operation is conceived as calendering performed by means of a supercalender, but that can be replaced by using e.g. a metal-belt calender of the type used in sequence III or any other type of calender suitable for the paper/board grade to be processed.

**Claims**

1. A paper/board manufacturing method, in which a paper/board web is re-moistened at some point between wet pressing (I) and rewinding (VI), **characterized** in that, prior to re-moistening, a paper/board web (W) is calendered and/or dried in at least one operation (III) with a metal-belt calender type processing assembly (1), comprising a metal belt (2) adapted to travel around at least one guide element (3), outside said belt being provided at least one counter-element (5) creating a contact surface with the belt, such that between the belt and the counter-element is established a web processing zone (N), the web (W) to be processed being passed therethrough, and in which processing assembly the processing zone length is adjustable by way of arranging the belt guide element and/or shaping the counter-element, in which method the contact time of a web with a metal belt is adjusted conveniently to the range of about 5-200 ms and the temperature of a metal belt is adjusted to the range of about 20-400°C, and in that, downstream of re-moistening (IV), the paper/board web is subjected to final calendering (V) with a desired calendering technique.

2. A method as set forth in claim 1, **characterized** in that the web is overdried (III) with the metal-belt calender type assembly (1) to a condition dryer than the final moisture, after which it is re-moistened in at least one operation (IV) prior to final calendering (V) or during final calendering.

3. An apparatus for implementing a method as set forth in claim 1 or 2, **characterized** in that the apparatus comprises at least one metal-belt calender type processing assembly (1), located at some point downstream of a press (I) and used for treating a paper or board web, comprising a metal belt (2) adapted to travel around at least one guide element (3), outside said belt being provided at least one counter-element (5) creating a contact surface with the belt, such that between the belt and the counter-element is established a web processing zone (N), the web (W) to be processed being passed therethrough, and the length of said processing zone being adjustable by way of arranging the belt guide element and/or shaping the counter-element, and at least one re-moistening assembly, which is located at some point downstream of the processing assembly (1) and downstream

of which is provided an assembly performing final calendering (V) in one or several operations.

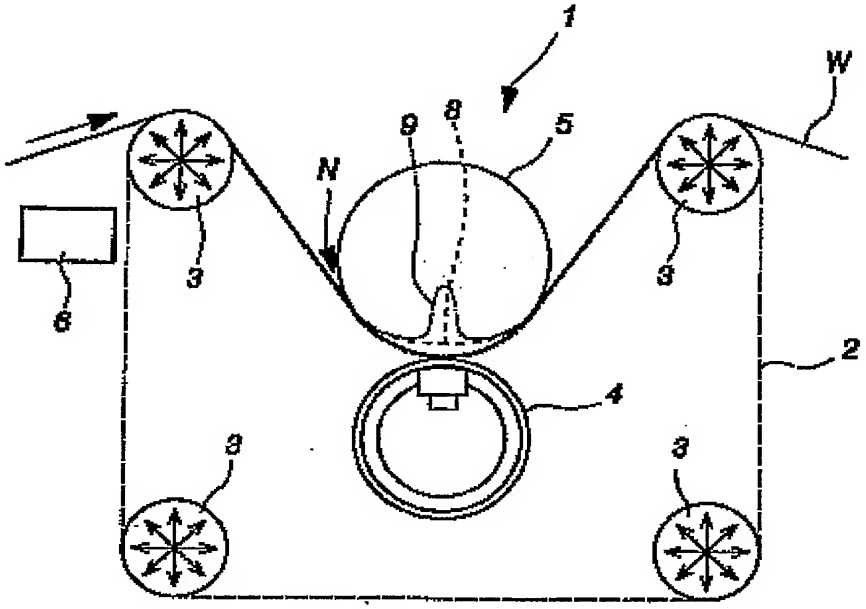


Fig.1

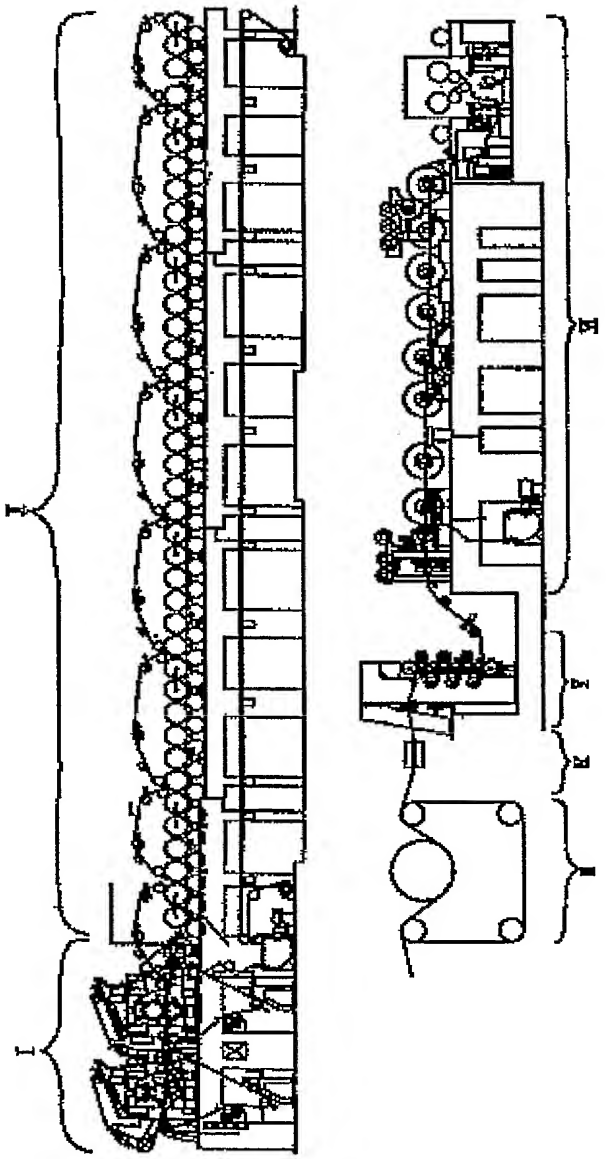


Fig. 2

# INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21G 1/00, D21F 5/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F, D21G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
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| 16 July 2004 | 21 -07- 2004 |
| Name and mailing address of the ISA/<br>Swedish Patent Office<br>Box 5055, S-102 42 STOCKHOLM<br>Facsimile No. +46 8 666 02 86 | Authorized officer<br>Nils Nordin/MP<br>Telephone No. +46 8 782 25 00 |

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International application No.
PCT/FI 2004/050038

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Information on patent family members

30/04/2004

International application No.
PCT/FI 2004/050038

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**TITLE:** APPARATUS AND METHOD FOR MANUFACTURING PAPER OR BOARD AND THUS MANUFACTURED PAPER OR BOARD

**PUBN-DATE:** November 11, 2004

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| KOJO MARKKU | FI |
| TORVI TIMO | FI |
| RAEMOE TUOMO | FI |
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| REMMI SAMI | FI |

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**EUR-CL (EPC):** D21G001/00 , D21G001/00

## ABSTRACT:

CHG DATE=20041123 STATUS=O>The invention relates to a paper/board manufacturing method, in which a paper/board web is re-moistened at some point between wet pressing (I) and rewinding (VI), and to an apparatus for implementing the method. In the method, prior to re-moistening, a paper/board web is calendered and/or dried in at least one operation (III) with a metal-belt calender type processing assembly (1), comprising a metal belt (2) adapted to travel around at least one guide element (3), outside said belt being provided at least one counter-element (5) creating a contact surface with the belt, such that between the belt and the counter-element is established a web processing zone (N), the web to be processed being passed therethrough. In the processing assembly, the processing zone length is adjustable by way of arranging the belt guide element and/or shaping the counter-element. Downstream of re-moistening (IV), the paper/board web is subjected to final calendering (V) with a desired calendering technique.